

ANALYSES OF TWO EXISTING STORMWATER DRAINAGE LINES OF SURAT IN WEST ZONE USING BENTLEY STORMCAD

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Abstract—In modern cities the stormwater drainage system is the essential part of the urban infrastructures. Basically the most important use of the stormwater drainage system is to carry the excess rain water in the monsoon season from the roads, streets and roofs and make the city free from the problems of back flow and also from the flood. In Surat city, West zone is resting under the criteria of low lying coastal areas which directly causes the backflow and flooding during high intensity of rain. To overcome these problems, simulation of the existing network of the West zone is essential which carried out by using StormCAD.

Index Terms—Smart cities, Storm Water Drainage System, Surat, Simulation, StormCAD.

I. INTRODUCTION

Water which originates during precipitation events and snow/ice melts is known as stormwater. During rain, the water which does not soak into the ground becomes a surface runoff which flows from the storm drainage lines to the river or streams. Stormwater Drainage System mainly used to detect the issues related to flood control and water supply (Volume and timing of runoff water) and also related to water pollution. In developing countries the factors which are affecting the stormwater drainage system classified into two categories: 1) Natural 2) Human activity. Rainfall patterns, Properties of catchment areas, soil type, presence of water course, climate change etc are the natural factors. Extension of urban areas, impermeability, degradation of plant cover, lack of planning and poor management and such are the Human activities that impacts on natural storm drainage.

Conduits with different diameters, manholes, catchment areas, outlets and alike are the important elements of any storm water drainage systems. The main purpose of the system is to carry out the excess rain water from the lands occupied by human settlements to the nearby water bodies like ponds, rivers or streams.

II. STUDY AREA PROFILE

Surat city is located at the bend of the Tapi River. The natural slope of the city is North-East to South-West. The average annual rain of the Surat is 1143 mm. In Surat, stormwater flows from the un-built open surface drains and joins nearby Tapi or Khadi. The existing network discharge stormwater into Tapi River at 16 locations in seven zones of the city. In current paper, the study is carried out in the West zone of the city. The total area of the West zone is about 51.279 km² [1].

In West zone the total number of outfall is 10. The simulation is carries out for two main lines of the stormwater drainage system;

- 1) Ugat canal road to Pal outfall;
- 2) Town Planning Scheme 46 (Jahangirpura) to Palanpur canal borrow pit to Tena Khadi.

Total length of the both network is 17.154 km. Total area covered by the network is 1092.154 Ha.

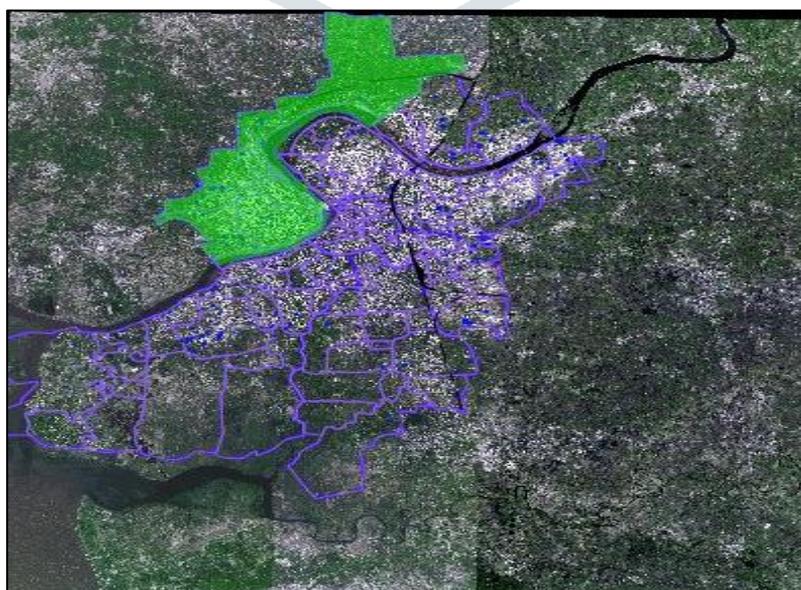


Figure 1 Boundary of West zone of SMC

(Source: GIS portal, SMC)



Figure 2 Two main lines of storm water drainage network

III. DATA COLLECTION

A CAD file of the existing Stormwater Drainage Network of two trunk lines with catchment areas and IDF curve (Intensity-Duration-Frequency curve) of West zone was obtained from the Drainage Department (Surat Municipal Corporation-SMC). The file includes the diameter of each pipe with manholes and also consist the reduce level (RL) of each point in the whole network. In existing network, total 2 numbers of outfalls with their RL and IL (Invert level) are available. One outfall meets Tapi River while another outfall meets to the canal. The detail of two main existing lines in the network in the CAD file is illustrated in figure 4.

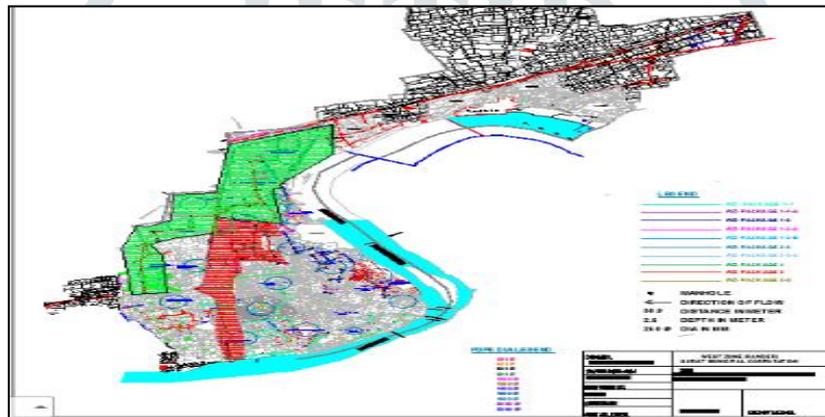


Figure 3 Catchment area of covered network by SMC

(Source: Drainage Department of West zone, SMC)

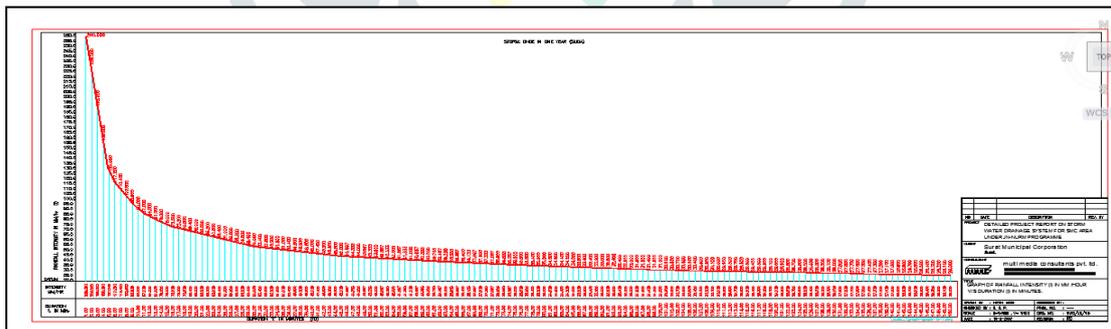


Figure 4 IDF Curve of the storm drainage network of study area

(Source: Drainage Department of West zone, SMC)

IV. ANALYSIS USING STORMCAD

StormCAD Vi8 can be use for the whole phases of the project like analysis of the existing network to the final design of the network or new design of the whole network [2]. General uses of the StormCAD are;

- To design multiple stormwater lines;
- To analyze different scenarios for stormwater network;
- Import and export AutoCAD and .DXF files.
- Predict runoff of rainfall [2].

Different steps for the analysis of two main lines of the existing network in west zone by using StormCAD:

- 1) Opening of new project option in StormCAD;
- 2) Adding IDF curve in Storm Data;
- 3) Put the background of the existing network by converting AutoCAD file into .DXF file;
- 4) Tracing main lines and catchment areas in StormCAD with the help of background files;
- 5) Color coding of the pipe as per their diameters;

- 6) Inserting invert level, ground elevation in each manhole;
- 7) Inserting conduit properties and manning's values in each conduit;
- 8) Inserting time of concentration and runoff coefficient in each catchment;
- 9) Validate and simulate the program.

After running the program successfully, the software itself calculates the flow and hydraulic grade lines in each manhole and slopes, flow and velocity in each conduit.

V. DEVELOPING A MODEL IN STORMCAD

By inputting all the existing data in the StormCAD the simulation is carried out. In manhole, the data of elevation, invert level, width and length and structure type is inserted. In conduits, the diameter, types of conduit structure, material, manning's values are inserted. In catchment, runoff coefficient and time of concentration is added. After computing successfully, the flux table of out fall, conduits and manhole is studied out. The software itself calculates the velocity and flow in each conduit from the inserted data. Here the rational method is used in the software for the calculation. The network of two lines of existing drainage system in StormCAD is also given below in the figure 5.

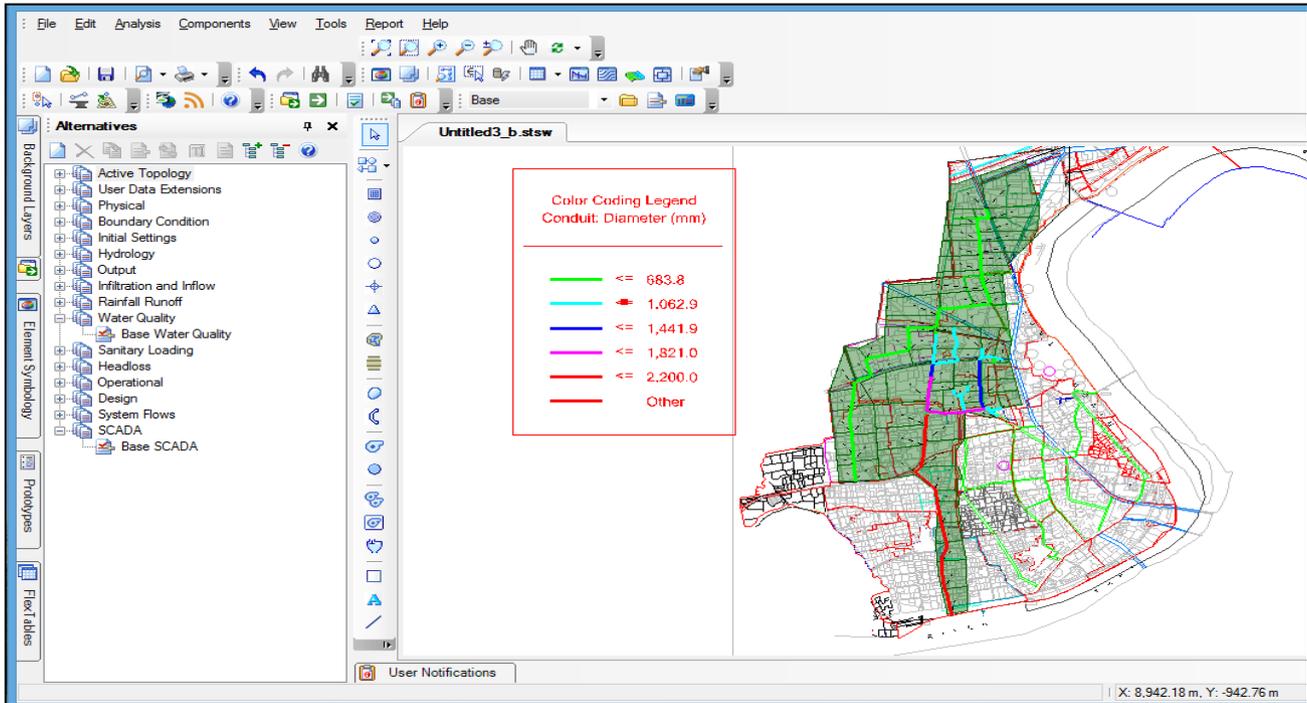


Figure 5 Screenshot of two lines of Stormwater Drainage in StormCAD

The system comprises of network pipes (circular) and box drains. Pipe diameters have a variation ranging from 900 mm to 2200 mm. The box drain size has dimensions of 2.2 m x 2.2 m to 3.2 m x 3.2 m. system pipes are made up of concrete (Hume pipes) and box drains are of concrete as well. The invert levels have a depth ranging from 3.055 m to 7.956 m from the ground level. Total length of network is 17.154 km having a total 625 manholes. The analyzed network has 688 conduits of either types.

Study shows that there are some manholes which overflows and causes the problem of backflow in those areas during high intensity of rainfall. The profiles of these manholes are creating by StormCAD which clearly indicate the over flow. In which, HGL means Hydraulic Grade line and EGL means Energy Grade Line. If the green line is below the both lines then manhole is over flooded. The profile of the normal manholes and manholes with the over flow is given in the figure 4 and figure 5.

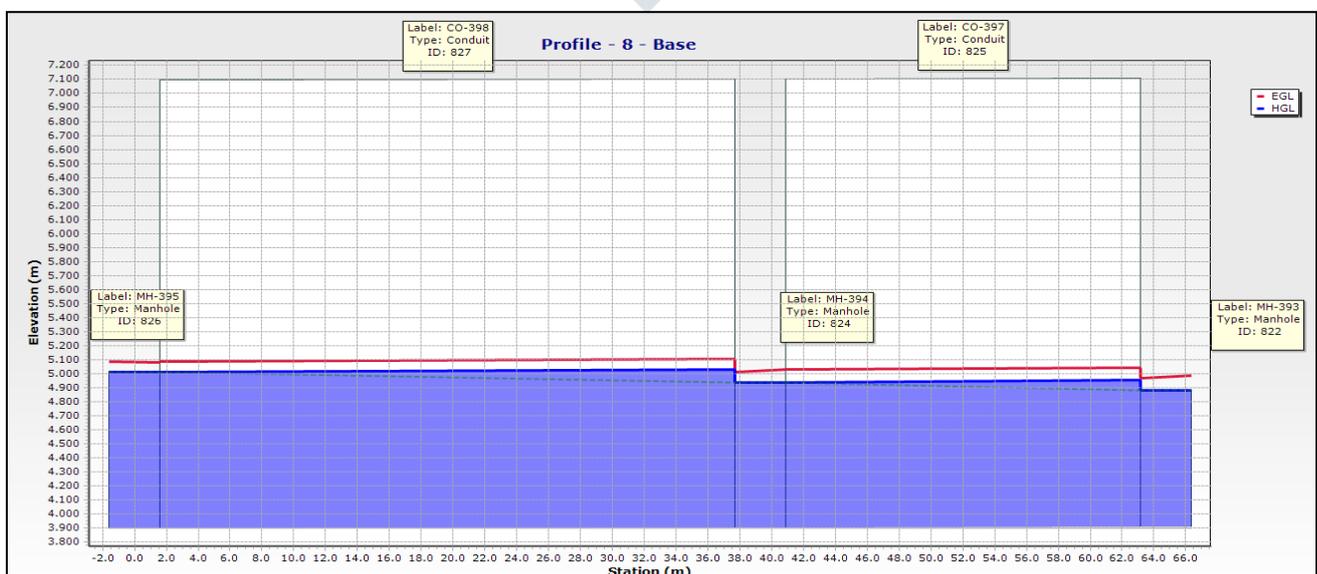


Figure 6 Profile of over flowing manhole

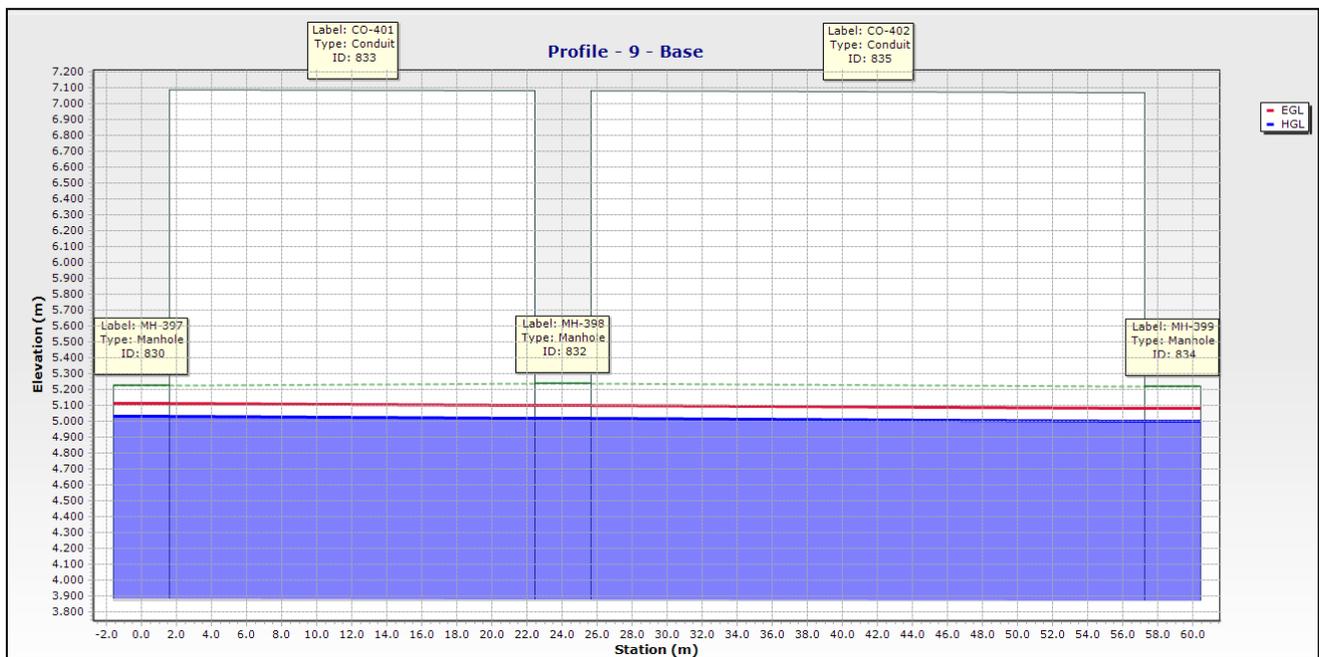


Figure 7 Profile of normal manholes

VI. RESULTS & DISCUSSION

The main purpose of the paper was to analyze the existing situation of the two main Stormwater drainage systems in West zone of Surat city by using StormCAD tool. Data which are collected from the Surat Municipal Corporation, inserted in the software and the simulation of the existing network is carried out. The result indicates that some manholes are overflow in the system which causes the problem of water logging in some areas for some period of time during the high intensity of rainfall.

Based on the system simulated using the software, it was identified that there are possibilities of overflowing of six manholes in the selected network. The system is not looped and acts as an independent network for draining the catchment area.

MH no. 393, 394 and 395 located (refer figure 6 above) on the Old Ugat road are showing a condition of over flow (dashed line show the ground level). The elevation of these places is 4.883 m, 4.940 m and 5.014 m respectively. The manhole is also over flow near Gopinath society (MH no. 269) which has the elevation of 6.900 m. Such problems need to be addressed using an online sensor-based system installed in the existing network. It poses a demand for network upgradation towards a share in making a Smart city. With the help of these types of system, issues can be detected quickly and addressed accordingly. Thus, Bentley StormCAD can be very convenient and useful tool for the design and the analysis of the storm water drainage system.

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VIII. REFERENCES

- [1] "Zonewise Area, Population, Density and Decadal Growth of SMC _ Surat Municipal corporation."
- [2] B. Stormcad *et al.*, "Welcome to Bentley StormCAD V8 Help," pp. 13–577.